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ABSTRACT

This study presents some highlights of what research tells the practitioner about the motor learning of children. Major emphasis is on motor learning in relation to the physical and motor characteristics of the child's maturation and development. In the first three sections of the study, general ideas concerning motor learning are discussed. Topics presented include the following: (a) maturation and motor learning; (b) development and motor learning; and (c) transfer and motor learning. The final sections of the report concentrate on more specific aspects of the motor learning of children, focusing on the following age groups: (a) infancy: ages 0-2; (b) early childhood: ages 2-6; and (c) late childhood: ages 6-12. Research dealing with factors known to influence the motor learning of children, such as appropriate levels of sensory stimulation, critical learning periods, exposure to a variety of basic skills, the child's interest, motor readiness, and sex differences is also reviewed. The study concludes that more research is needed in many areas concerned with motor learning of children, including the following: (a) various learning phenomena in relation to children's acquisition of motor skills; (b) the influence that the learning of motor skills has on the child's social, intellectual, and emotional development; and (c) the kind of experiences, amount of exposure to each experience, and timing of introduction of each experience in order for learning to be most effective. (JS)

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The Motor Learning of Children

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THE MOTOR LEARNING OF CHILDREN

Introduction

The purpose of this paper is to report on what research tells the practitioner about the motor learning of children. However, before focusing on that purpose I would like to comment on the emphasis of this paper which is chiefly limited to discussing motor learning in relation to the physical and motor characteristics of the child's maturation and development. This emphasis is not intended to minimize the importance of other maturational and developmental characteristics (e.g. social, intellectual, emotional) which interact in a complex way to exert their influence on the learning of motor skills. A child's motor learning is in harmony with all of his maturing and developing characteristics and his motor learning can be understood only in relation to all these characteristics.

Maturation and Motor Learning

When movement behavior is modified as a result of experience or practice, the change in behavior is attributed largely to the process of motor learning. In contrast, when a behavior sequence progresses through regular stages as a result of growth processes, but independent of experience or practice the change in behavior is credited mostly to the process of physical maturation. For example, improvements

in performance associated with ontogenetic skills such as swimming, skating, and riding a tricycle appear to be to a great extent the result of learning, whereas, changes in behavior linked with phylogenetic skills such as grasping, crawling, and walking seem to be chiefly controlled by maturation. Thus, the influence of learning may be greater in the development of ontogenetic skills and maturation may predominate in phylogenetic skills (Hottinger, 1973; Lawther, 1968; Rarick, 1961).

However, ontogenetic and phylogenetic skills develop through a complex interaction of both learning and maturation. For example, maturation provides the potential for running; opportunity is needed to bring about running behavior; and practice is needed to refine it. Hence, the motor learning of children is inextricably bound together with their maturation (Lockhart, 1973; Thompson, 1962). For the researcher, it is an experimental problem to distinquish what proportion of movement behavior was modified by learning and what proportion was modified by maturation, but I don't believe that the practitioner needs to become overly concerned with finding a solution to this problem. Instead, he should realize that maturation is a prerequisite for motor learning and that the child will not learn a motor skill before he has reached the appropriate maturational

level. Further, he should keep in mind that the process of motor learning in children can be understood only in relation to maturation and come to recognize the critical role of opportunity and experience in the acquisition of motor skills.

Development and Motor Learning

Ordinarily, the term development is used to define a series of changes which take place in an orderly and coherent pattern. An example of a developmental sequence in the first 2 years of life is that of mastering locomotion (Shirley, 1933). Development is a complex process of integration of the structures and functions of the body and it is the result of maturational and environmental influences combined. Now, how is the motor learning of children related to their development? Simply stated, the answer is that motor learning is subordinate to the laws of development.

Several authors (Espenshade & Eckert, 1967; Mussen, et al., 1969; Hottinger, 1973 and Lockhart, 1973) emphasize that all children tend to follow a rather consistent predictable pattern of physical and motor development and three patterns are evident:

1. Growth tends to progress from the head to the feet or in a cephalocaudal direction. Thus, the child is able to gain control over the upper parts of his body before he can gain control over the lower parts.

2. Growth tends to progress from the center of the body toward the periphery or in a proximodistal direction. As a result, the child is able to gain control over the medial parts of his body before he is able to gain control over peripheral parts.
3. Motor control tends to proceed from mass to specific. Therefore, the infant gains control over large gross movements before he gains control over smaller, more precise movements.

The rate of development differs considerably among children, primarily because each child is endowed with his own unique heredity characteristics. This is one reason why all children are not ready for the same motor skills at the same time.

Transfer and Motor Learning

It is important for the practitioner to understand the principle that with each year, motor learning becomes largely a matter of transfer (Hebb, 1961; Fitts & Posner, 1967; Lawther, 1968). Transfer refers to performance on one skill which influences performance on some subsequent skill. Transfer between skills depends on both stimulus and response similarity and generally speaking, the more alike the two skills are the greater the transfer between them (Holding, 1965). The point to remember is that after

the first 2 or 3 years of life, learning a completely new motor skill is an uncommon occurrence. To a great extent, new motor skills are developed on the foundation of previously acquired skills. The motor learning of skills is therefore largely a matter of transfer of previously acquired skills to the new skills which are about to be learned.

Up to this point I've been concerned with introducing some rather general notions about maturation, development, transfer and the motor learning of children. However, the remainder of this paper will concentrate on more specific aspects of the motor learning of children. For convenience of presentation the material will be organized under the general headings of "Infancy: Ages 0-2", "Early Childhood: Ages 2-6", and "Late Childhood: Ages 6-12".

Infancy: Ages 0-2

The physical and neurological mechanisms which form the bases for all future learning are already present and are being developed. Progressive changes in motor behavior during this period are attributed chiefly to maturation. Motor learning during infancy seems to be largely a matter of structuring the proper environment, that is, presenting stimulation to which the infant can respond.

Research reported by Scott (1960) indicates that an environment with appropriate levels of sensory stimulation

is likely to produce desirable behavioral changes. What constitutes an appropriate level cannot be answered on the basis of the existing research. However, Brazelton (1971) points out that the level of stimulation must be appropriate to each baby's stage of development and there should not be under or overstimulation. Hottinger (1973) suggested that, "One practical procedure is to provide a rich varied environment and let the child choose from the stimuli rather than try to impose the environment on him.".

Evidence from studies on animals (Held & Bauer, 1967; Held & Hein, 1963; Melzack & Scott, 1957; Scott, 1962; Thompson & Melzack, 1956) supports the hypothesis that the absence of early learning experiences and opportunities can restrict the capacity for later learning. One might argue that evidence based on animal studies can not be generalized to human infants. However, there is some evidence (Gregory & Wallace, 1963; Held, 1968) based on human subjects which indicates that early experiences, or lack of experiences, do influence human development. Held (1968) states that, "Studies of the earliest development of sensorimotor coordination in higher mammals including man have shown that certain forms of contact with the environment are crucial for the growth of normal spatial behavior.". On the other hand, Dennis and Najarian (1957) and Malpass

(1960) have shown that unless deprivation of motor experiences are for extended periods of time, the child can usually overcome delays in motor development as he gets older.

Critical Learning Periods

Ordinarily, a critical learning period refers to the time following the age when the infant is first capable of performing the motor skill somewhat proficiently. Although, at present there is a dearth of research concerning the optimal time for learning motor skills the work of Gesell and Thompson (1929), Hilgard (1932), McGraw (1939) and Mirenva (1935) reveals that there seem to be various critical learning periods for when specific motor skills are most efficiently learned. These critical periods depend not only on the infant's age, but on his maturational level as well. Thus, successful acquisition of a variety of motor skills does not depend upon how early the infant experiences the skills, but instead upon when the experiences are introduced in relation to the infant's maturational level. When the infant is "mature enough", he will learn a given motor skill most efficiently (Hicks, 1930a,b,; Hicks & Ralph, 1931: [redacted]). Scott (1962) went so far as to say, "Any attempt to teach a child or animal at too early a period of development may result in his learning bad habits, or simply in his learning "not to learn",

either of which results may greatly handicap him in later life.".

Early Childhood: Ages 2-6

The progressive maturation of the child's physical and neurological mechanisms lays the foundation for increased skill in motor activities. Learning plays more and more of a role in motor performance improvements, but as with infants, broadening of the repertoire of motor skills must await physical and neurological maturational development (Mussen et al., 1969; Wild, 1938).

Variety of Basic Skills is Important

This period of early childhood may be viewed as a time for building many different fundamental motor skills which, if adequately perfected, may be used as a base for developing more complex motor skills in the future (Bloom, 1964; Gesell & Lord, 1927; Jersild, 1932; Lawther, 1968; Singer, 1973; Staats, 1968). By the end of this period the average child has acquired a variety of basic motor skills at some level of proficiency. The work of Bayley (1935), Deach (1951), Gutteridge (1939), Halverson and Robertson (1966), Life (1971), McGraw (1935), Mead (1958), and Wild (1938) indicated that the average child can run, jump, hop, gallop, skip, throw, catch, kick, bounce a ball, strike, and if given the opportunity he can also learn to swim and roller skate.

The acquisition of a variety of basic motor skills provides advantages to the child which extend beyond the satisfaction produced by that acquisition. It permits the child to become more and more independent, it provides him with a means by which he can interact with other children, and it is likely to be a positive influence on the development of his self-concept. As Havighurst (1953) stated, "To an increasing extent, a child's conception of himself is tied up with the skills he has. It is as though his acceptance of himself comes in part from his ability to master different forms of the world outside himself.".

Capitalizing on the Child's Interests

Early childhood is a period when the child likes to play, experiment, and explore. He should have the opportunity to do so because it is through these means that he comes to develop many motor, intellectural, social, and emotional abilities. Let the child play, experiment, and explore, and within reason let him set his own pace. Avoid structuring situations that will create fear or anxiety in him. When children are involved in games, allow them to make up their own rules and regulations. For the most part then, the motor learning of skills should be left to play, experimentation, and exploration. Such motor learning sessions should place more emphasis on the object of the

movement or on problem solving, rather than the mechanics of the movements themselves. However, if the purpose of the session is to master a particular motor skill, it should be obvious that more emphasis must be placed on the movements themselves.

Toys are important to the child's play and his development during early childhood. Espenshade and Eckert (1967) say, "Toys are, at one and the same time, the instruments of play and the tools by which children develop their gross and fine motor abilities.". Examples of some favorite toys of children include blocks, balls, push and pull type devices, wagons, kiddie cars, a tricycle, a pair of roller skates and a bicycle. Kawin (1934) recommends that the child have at least 5 types of toys and these include; (1) toys for developing strength and a variety of motor skills; (2) toys for dramatization and imitation; (3) creative constructive toys; (4) toys for developing artistic abilities; and (5) toys providing opportunity for intellectual development. In addition, toys should be safe, sturdy, and should be able to be manipulated by the child, that is, they should not be motor driven.

Differences in Motor Readiness

During this period boys and girls are about equal in their motor development. However, for both sexes there are

marked individual differences in "readiness" for motor skills (Lockhart, 1973). All children are not ready for the same motor skill at the same age. Consequently, the learning of motor skills and the expectancies concerning motor performance should be individualized in relation to the child's maturational level. Opportunity should be provided for the child to experience a reasonable degree of success in his motor performance. An environment in which the child experiences repeated failure in motor activities is likely to be detrimental to his development. Unfortunately, research provides us with no exact rules which can be used to help the practitioner in deciding when a child is ready for a specific motor skill. The perceptive, experienced practitioner says he can tell when the time is right because the child has his own ways of letting him know. This certainly isn't much to go on for determining when motor learning comes easy and for providing the environment and materials for motor learning. To pursue this task on the basis of the information available is a bit frightening, but nonetheless, the practitioner is obligated to do so.

Late Childhood: Ages 6-12

The late childhood period is ideal for learning motor skills. The physical and neurological mechanisms are becoming developed to the degree that the child can refine

and build on the basic motor skills that were acquired during infancy and early childhood. The first part of this period finds the child having some difficulty in mastering fine manipulative skills, but by the end of this period his motor behavior is rather well integrated.

Differences in Motor Readiness

Maturational influences and individual differences in motor readiness for both sexes are still present in late childhood. Instruction should be individualized as much as possible and the child should not be introduced to certain motor skills before he is capable of acquiring them. Lockhart (1973) also stressed individualized instruction and stated, "Emphasis should be put on the child's own progress, not on comparing his achievements with those of others. So great are individual differences that even by the fourth grade there may be a gulf between youngsters as wide as a six year span. Approaches and expectencies for motor learning must differ from individual to individual.". Scott, (1968) says, "Most children are not able to perform activities requiring good coordinations of the whole body much before the ages of 7 or 8, and introducing them too early to such activities only results in unskilled performance and failure.". Singer (1973) points out that many motor skills can be changed and modified to meet the child's motor

readiness level. He also emphasized that practice and special training produce desired results only when the child is maturationally ready. As with early childhood, there is agreement among the experts that instruction should be individualized, but there seems to be little scientific basis for determining when a child is ready for a certain motor skill. Nevertheless, the practitioners is still obligated to wrestle with this problem and provide the answer.

Sex Differences and Motor Learning

Motor performance on the basic skills (e.g. running, throwing, catching, jumping, balancing, striking) are gradually improved upon with age for both sexes (Seils, 1951). In addition, complex motor skills are built on already learned organization, that is, on existing basic skills. These complex motor skills usually include game, dance, and sport skills.

Boys have been found to perform better in those gross motor skills which demand strength and large body movements, whereas, girls usually perform better in fine motor skills which require a high degree of coordination and precision (Espenshade & Eckert, 1967; Keough, 1965; Jenkins, 1930; Singer, 1973; Yarmolenki, 1933). After reviewing the literature on this topic, Broverman et al. (1968) concluded

"...evidence exists that females exceed males in tasks that require rapid, skillful, repetition, articulation, or coordination of "lightweight," overlearned responses (perceptual responses, small muscle movements, simple perceptual coordinations).". It has also been found that boys continue to improve in the basic skills whereas girls usually do not, and the difference between their motor performances, which is slight in early childhood, increases with age (Espenshade, 1960; Latchaw, 1954).

However, the difference in motor performance at a given age and the difference in improvement in motor performance with age does not necessarily mean that sex is a factor in the potentialities for skill learning. It is likely, that these motor performance differences as a function of sex are largely due to sociocultural pressure to have boys engage in certain activities and girls in others. For example, the leveling off of improvement typically found in girls at later ages may be largely the result of pressure to become involved in activities other than the basic motor skills because they may not be considered "lady like". Therefore, if given the opportunity, it seems reasonable to expect that girls could learn motor skills about as equally as boys.

Other Motor Learning Considerations

Exposure to a variety of skill opportunities is important

for developing a wide range of motor skills and for developing physical abilities such as strength, endurance, flexibility, balance, agility, speed, and coordination. The skill opportunities should also be designed to contribute to the child's self-esteem, body image, peer acceptance, and social behavior. During the early years of this period children are interested in swimming, rhythmic and dramatic experiences, movement exploration, simple movement activities, and games of low organization. In the later years children are interested in more complex motor skills and instruction can be started in skills such as: golf, tennis, baseball, gymnastics, basketball, and soccer. Children are capable of specializing at this level, but it would seem best to have them experience a variety of skills and allow true specialization to come later.

During this period children are interested in free play and it is important for their motor development, but free play should be coupled with systematic instruction in motor skills. Although there has been some research (McDonald' , 1967; Miller, 1957) on instruction in children's motor learning, little is known about the age at which instruction becomes most meaningful. Singer (1973) proposes that it depends on the nature of the skill, the maturational readiness of the child, and the type of instructional procedure employed.

In order to learn a specific motor skill the goal must be clearly understood by the child. Further, he must be motivated to achieve the goal. Once the skill is demonstrated the child will form an "image for action" or an "idea" for what movements will have to be made as well as how to make them. The child should not be expected to reproduce the movements in the same form in which they were demonstrated. There are many movement variations which are acceptable approximations of the so called "correct way" for executing a skill (Ragsdale, 1950).

Ideally the skill can be practiced as a whole, but if the child cannot achieve success, the skill must be broken down into subskills and practiced as such. Once the subskills are mastered, they must then be practiced together as a whole. During the initial stages of learning the skill, when the child is likely to fatigue quickly, practice should be distributed. In other words, the skill should be practiced frequently, but not for too long a duration. In the later stages of learning, when the motivation which comes from success increases, practice periods can be lengthened.

Practice alone is not enough, the child must be helped to understand how his movements can be improved. He should receive knowledge of results about his performance but he

should not receive too much information. Don't analyze excessively during the early stages of learning. In order to keep the child motivated he should experience a reasonable amount of success in the skill. The motor behavior reflecting the success should be reinforced to promote learning. Remember, the learning of motor skills should be a pleasurable and satisfying experience, and not an experience in failure and frustration.

Concluding Remarks

Based on the literature reviewed, this paper attempted to present some highlights of what research tells the practitioner about the motor learning of children. This was a difficult task because of the lack of research on many aspects of children's motor learning. For example, there are relatively few studies which deal with various learning phenomena such as motivation, reinforcement, knowledge of results, transfer, practice, and retention and forgetting in relation to children's acquisition of motor skills. Another aspect that has received limited attention is the influence that the learning of motor skills has on the child's social, intellectual, and emotional development. One more aspect that has not been investigated extensively is related to the specifics of early motor experiences are important for the child's development,

the available research does not tell us about the kind of experiences, the amount of exposure to each experience, and when each experience should be introduced for learning to be most effective. Much work is still needed because as of yet research has not provided the practitioner with the scientific bases for knowing how to develop to the maximum all the motor learning potentials of the child.

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